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flew as rapidly and with as much apparent vigor as in September. Farther search failed to discover others at the time. Two weeks later *three others were killed*, and in the first week of February, *one more*. These latter specimens were equally fat and vigorous. No similar circumstance has come under our notice.

Similar instances of the presence of the Night Heron (*Nyctiardea Gardenii*) have three times come under our notice. We have found these birds sitting on trees near springs, from whence the water flowed swiftly, and about which the grass remained quite fresh. Leaving them undisturbed, but watching them frequently, they were never seen to leave their perch. From the accumulation of droppings it was evident that the particular branch even, on which they were first seen, was that on which they had been resting for some time past. Only single specimens have been thus found, all male birds, and they have always been much emaciated. When forced to move they all proved able to fly, but returned to their accustomed place, after a circuitous flight of short duration. Were they too old to go South? Did they get any food? If so, what and where? On dissection the stomachs of these three specimens proved to be empty, but the *uppermost droppings were fresh!*

THE FORMER EXISTENCE OF LOCAL GLACIERS IN THE WHITE MOUNTAINS.*

BY PROFESSOR L. AGASSIZ.

TWENTY-THREE years ago, when I first visited the White Mountains, in the summer of 1847, I noticed unmistakable evidences of the former existence of local glaciers. They were the more clear and impressive to me because I was then fresh from my investigations of the glaciers in Switzerland. And yet, beyond the mere statement of the fact that such glaciers once existed here, I have never published a detailed account of my observations, for the simple reason that I could not then find any limit or any definite relation between the northern drift and the phenomena indicative of local White Mountain glaciers; nor have I ever been able since to revisit the region for more careful examination. This year a prolonged stay among these hills has enabled me to study this difficult problem more closely, and I am now prepared to show that the drift, so-called, has the same general characteristics on the northern and southern side of the White Mountains. Whatever, therefore, may have been the number of its higher peaks which at any given time, during the glacial period, rose above the great ice sheet which then covered the country, this mountain range offered no obstacle to the southward movement and progress of the northern ice fields. To the north of the White Mountains as well as to the south, the northern drift consists of a paste more or less clayey or sandy, containing abraded fragments of a great variety of rocks, so impacted into the minutely comminuted materials as to indicate neither stratification nor arrangement or sorting, determined by the form, size or weight of these fragments. Large boulders and pebbles of all sizes are found in it throughout its thickness, and these coarser materials have evidently been ground together with the clay and sand under great pressure, beneath heavy masses of ice; for they have all the characteristic marks so unmistakable now to those who are familiar with glacial action: scratches, grooves, furrows, etc. These marks are rectilinear, but they cross each other at various angles, thus showing by the change in their direction that the fragments on which they occur, though held for a time in one and the same position while these straight lines were engraved upon their surface, nevertheless changed that position more or less frequently.

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* Read, in the absence of Professor Agassiz, by J. B. Perry, before the American Association for the Advancement of Science, Troy meeting, Aug., 1870.

A few flatter fragments with more angular outlines show only one kind of scratches, having evidently been held for a longer time in the same position. This drift, however it may vary in its mineralogical components in different localities, exhibits everywhere the same characteristic treatment over the whole country, from the shores of the Atlantic to the Rocky Mountains and beyond. In the White Mountain region it has the same mineralogical character north and south of the range, and rests everywhere upon the well known *roches moutonnées*, in one word, upon the planed, grooved, polished and scratched surfaces of the rocks underlying it.

Observation has taught us that materials such as those described above, so combined, exhibiting the same characters in their surfaces and having the same diversity of composition and absence of all sorting or regular arrangement, occur now at the bottom of the great glaciers of our time, and nowhere else; being found between the ice and the rocks over which it moves,—the result in fact of the grinding action of advancing glaciers. On account of their unvarying position I have called these deposits "ground moraines," because they are always resting upon the rocky floor of the country, between it and the under surface of the ice. Our typical unaltered so-called *northern* drift is synonymous with the ground moraines of the present day, differing only in its greater extension. It is in fact a ground moraine spreading over the greatest part of the continent. All its characteristics, identical in every detail with those of the deposits underlying the present glaciers, show that it can only have been formed under a moving body of ice, held between it and the underlying mass of rock. The great ice sheet of the glacial period which fashioned the drift must therefore have been co-extensive with the distribution of the latter. It is very important to distinguish this drift from the moraines formed under other circumstances, and from the so-called erratics and perched blocks. Moraines, as commonly understood, that is, lateral and frontal moraines, consisting of loose materials collected along the sides and at the terminus of a glacier, always indicate, and, where undisturbed, actually define the margins of a moving mass of ice; whereas the so-called median moraines formed along the line of junction of the glaciers are carried upon the back or upper surface of the ice, and always consist of angular materials, the shape and arrangement of which are determined by their mode of accumulation. Just as among the glaciers of the present day we discriminate between ground moraines, lateral, frontal and median moraines, so must we also distinguish between the same phenomena in past times. The glacial period had also its ground moraines, its lateral, its frontal and its median moraines, its erratics and perched boulders. But the huge ground moraine of the earlier ice time stretched continuously, like the ice sheet under which it was formed, over the whole country—from the Arctics to the Southern States, and from the Atlantic to the Rocky Mountains. I do not speak of the western slope of the Continent, because I have not examined it personally. The great angular erratics of that period were scattered irregularly over the country, as the few large boulders are scattered on the upper surface of a glacier now. It is the contact of the more limited phenomena of the local glaciers which succeeded this all embracing winter (their lateral, frontal, median and limited ground moraines and their erratics), with the more wide-spread and general features of the drift that I have been able to trace in the White Mountains this summer. The limits of this paper will not allow me to do more than record the general facts, but I hope to give them hereafter more in detail and with fuller illustrations. The most difficult part of the investigation is the tracing of the erratics to their origin; it is far more intricate than the identification of the origin of ordinary drift, or of continuous moraines, because the solution of the problem can only be reached under favorable circumstances where boulders of the same kind of rock can be followed from distance to distance, to the ledge *in situ* from which they were detached. Now, in the neighborhood of the White Mountains, we find beside the typical or northern drift, large erratic boulders as well as lateral, frontal and median moraines. A careful examination of these shows beyond a doubt that they came from the White Mountains and not from the northern regions, since they overlie the typical drift which they have only here and there removed and modified. A short description of the facts will leave no doubt upon this point.

The finest lateral moraines in these regions may be seen along the hillsides flanking the bed of the south branch of the Amonoosuck, north of the village of Franconia. The best median moraines are to the east of Picket Hill and Round Hill. These latter moraines were formed by the confluence of the glaciers which occupied the depression between Haystack and Mt. Lafayette, and that which descended from the northern face of Lafayette itself. These longitudinal moraines are particularly interesting as connecting the erratic boulders on the north side of the Franconia range with that mountain mass, and showing that they are not northern boulders transported southward, but boulders from a southern range transported northward. But by far the most significant facts showing the great extent of the local glaciers of the White Mountain range, as well as the most accessible and easily recognized, even by travellers not very familiar with glacial phenomena, are the terminal moraines to the north of Bethlehem village, between it and the northern bend of the Amonoosuck river. The lane starting from Bethlehem street, following the Cemetery for a short distance, and hence trending northward, cuts sixteen terminal moraines in a tract of about two miles. Some of these moraines are as distinct as any I know in Switzerland. They show unmistakably by their form that they were produced by the pressure of a glacier moving, from south, northward. This is indicated by their abrupt southward slope, facing, that is, toward the Franconia range, while their northern face has a much gentler descent. The steeper slope of a moraine is always that resting against the glacier, while the outer side is comparatively little inclined. The form of these moraines, therefore, as well as their position, show that they have come down from the Franconia mountains. A few details concerning their location may not be out of place, in order that any visitor interested in the facts may readily find them without a guide. The ground to the north of Bethlehem slopes gently northward, and is not wooded for about half a mile from the street. Following the lane above mentioned, the first moraine reached skirts the edge of the wood and is near the houses of Mr. Phillips; there are four others more or less distinct before reaching a little trout brook called "Barrett's Brook." The lane descends more rapidly toward the brook than before, and where the descent begins to be steep the eye commands the space between the brook and a higher ground on which stands a house owned by Henry McCulloch. Over that interval six very fine moraines may be counted, one of which is perhaps the finest specimen of a terminal moraine I have ever seen. Beyond McCulloch's there are five more, not quite as distinct. The ground beyond the termination of the glacier of the Rhone in Switzerland is celebrated for its many distinct concentric terminal moraines; but here we have a field over which within the same area a larger number of such moraines may be seen, and I believe that a pilgrimage to this spot would convert many a sceptic to the true faith concerning the transportation of erratic boulders, especially if he has seen the glacier of the Rhone and can compare the phenomena of the two localities.

The Littleton road from Bethlehem, and the roads to Franconia Notch from both these towns frequently intersect terminal moraines. Those familiar with the topography of the Franconia range and its relation to Picket Hill and the slope of Bethlehem, will at once perceive that the glacier which deposited the front moraine to the north of Bethlehem village must have filled the valley of Franconia to and above the level of the saddle of Picket Hill, making it at least fifteen hundred feet thick, if not more; thicker in short than any of the present glaciers of Switzerland. It will be observed, also, that as soon as the northern portion of that glacier had retreated to the wall which encircles the Franconia Valley on the north, the glacier occupying henceforth a more protected valley within the ranges, must have made a halt and accumulated at this point, that is, south and west of the saddle of Picket Hill, a very large terminal moraine. This moraine actually exists to the present day, and is one of the most characteristic features of the distribution of erratics in these regions. From the moment the glacier was reduced to the level of Franconia bottom it must suddenly have vanished entirely from the whole valley, and thus it happens that no other large terminal moraines are seen between that just mentioned and the higher range of Franconia.

Moraines similar to those observed on the northern side of the White Mountains exist also on their southern side in the vicinity of Centre Harbor. Lateral moraines may be traced at the foot of Red Hill, a little above Long Pond; also along Squam Lake. Median moraines are very distinct near Centre Harbor Hotel. Terminal moraines are also numerous near Centre Harbor and in the neighborhood of Meredith. At the southern end of Red Hill the lateral moraines trend westward and show their connection with the terminal moraines. These facts, taken in their relation with those enumerated above, show that there were local glaciers, on the southern as well as the northern slopes of the White Mountain ranges, moving in opposite directions; those on the northern slope moving northward, and those on the southern slope moving southward. I have seen no evidence thus far of these northern glaciers extending beyond the range of hills which separates the Amonoosuck River from the Connecticut River valley west of Lancaster, nor have I traced the southern glaciers beyond Lake Winnipesaukee. Traces of an eastern glacier moving westward may be seen near the Twin Mountain House; but I have not examined that region with sufficient care to give minute particulars.

All these moraines and traces of local glaciers overlie the typical or northern drift so-called, wherever the latter has not been entirely swept away by the local glaciers themselves; thus showing that the great ice sheet was anterior to the local glaciers, and not formed by a spreading of smaller preëxisting glaciers. At least, wherever I have recognized traces of circumscribed glaciers in regions where they no longer exist, it has always appeared to me that the minor areas covered by ice were remnants of a waning sheet of greater extent. If the glacial period set in by the enlargement of limited glaciers already formed and gradually spreading more and more widely, as Lyell and the geologists of his school suppose, the facts which would justify such a view are still to be made known. I have not seen a trace of them anywhere. On the contrary, throughout the ranges of the Alps, in the Black Forest, the Vosges, as well as in the British Islands, in Scotland, Wales and Ireland, I have everywhere satisfied myself that the more extensive the glaciated areas, indicated by polished surfaces and moraines in any given locality, the older they are when compared with glacial phenomena circumscribed within narrower limits.

It therefore follows from the facts enumerated above, as well as from a general consideration of the subject, that the local glaciers of the White Mountains are of more recent date than the great ice sheet which fashioned the typical drift. On another occasion I hope to show that the action of the local glaciers of the White Mountains began to be circumscribed within the areas they covered, after the typical drift had, in consequence of the melting of the northern ice sheet, been laid bare in the Middle States, in Massachusetts and Connecticut, after even the southern portions of Vermont, New Hampshire and Maine had been freed, and when the White Mountains, the Adirondacks and the Katahdin range were the only ice clad peaks in this part of the continent.

When in their turn the glaciers of the White Mountain region began to melt away, the freshets occasioned by the sudden large accumulation of water remodelled many of these moraines and carried off the minute materials they contained, to deposit them lower down in the shape of river terraces. I have recently satisfied myself, by a careful examination, that all the river terraces of the Connecticut River valley and its tributaries, as well as those of the Merrimack and its tributaries, are deposits formed by the floods descending from the melting glaciers. What President Hitchcock has described as sea-beaches and ocean bottoms near the White Mountain and Franconia Notches, as well as in the Connecticut River valley and along the Merrimack, have all the same origin. The ocean never was in contact with these deposits, which nowhere contain any trace of marine organic remains.

NATURAL HISTORY MISCELLANY.

BOTANY.

RICHARDSONIA SCABRA, a tropical American Rubiaceous weed, has every now and then been picked up and sent us from Georgia or Alabama; and if it is Pursh's *Spermacoce involucrata*, as is probable, it was introduced more than half a century ago. It appears that it is now taking wide possession of the soil in the piney region, and that it may play an useful part. Dr. F. J. B. Rœhmer, of Mobile, Alabama, writes of this plant as follows:

"This plant was comparatively rare here twenty years ago, but is now very common throughout the piney wood region of Alabama skirting the Gulf coast. It seems to choke out all the grasses by its more luxuriant growth. It is known by farmers, as "Mexican Clover," and may possibly have been introduced during the Mexican war, as it is said to grow in the rear of Vera Cruz. It is relished by all kind of stock, either green or cured.

In my capacity, during our late war, as botanist and chemist for the de-